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Sleep Breathing Disorders

The expansion of the hypopharynx by correction of glosso-larynx

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Abstract The width of the hypopharynx and oropharynx before and after the operation correction of glosso-larynx (CGL) was compared by cranial X-ray film. After the operation, the hyoid bone was seen to have moved downward, and the cranial bone was observed to have rotated forward. As a result, the hypopharynx and the oropharynx were expanded. Expansion of the hypopharynx resulted in the decreased resistance of flow decreased and the increased in airflow.

Key words airway, ankyloglossia with deviation of the epiglottis and larynx, larynx, partial genioglossectomy, sleep, tongue.

INTRODUCTION

Sleep disorders occur in humans of all ages. Symptoms of sleep disorders in infants are waking up easily, colic cry, snoring and apnea.[1–3] Children with sleep disorders move around during sleep and display bad temper when waking in the morning.[4] Adults exhibit snoring, apnea, and fatigue. We have already performed correction of glosso-larynx (CGL) or partial genioglossectomy (PGG) in such patients. After the CGL, we observed a decrease of apnea, an increase of SaO_2, an increase in volume capacity (VC) and an increase in 1%VC.[5] After the CGL, all patients report that they are able to breathe easier than they could before the operation. This suggests that resistance in the airway decreased.[6] We measured changes of the hypopharynx before and after the CGL, and found after the operation the hypopharynx had expanded.

Correction of glosso-larynx or partial genioglossectomy involves cutting the connective tissue of the tongue, including the septum linguae and the several frontal bundles of the genioglossus muscles. As a result, the tongue and the larynx go down and the larynx becomes aligned with the nasopharynx.[1,4] The operation has to finish the wound open.

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METHOD AND RESULTS

Correction of glosso-larynx was performed on 30 adults who complained of snoring, sleepiness in the daytime, apnea and fatigue. We studied the following five items by head and neck X-ray before and after CGL (Fig. 1). The mean increment of each measured after CGL are shown in parentheses with *P* value determined by paired *t*-test at the end of each item.

1. The shortest vertical length between the hyoid bone and mandible (+1.075 cm, $P < 0.0001$).
2. A vertical length between the hyoid bone and the tangent of C2–4 (+0.406 cm, $P = 0.0003$).
3. The shortest length between the hyoid bone and the chin (+0.295 cm, $P = 0.0396$).
4. The angle of the hyoid bone and the tangent of C2–4 (+3.3 degrees, $P = 0.016$).
5. The length of H–M (H is an intersection of a tangent of C2–4 and vertical line from the hyoid bone. M is an intersection of a tangent of C2–4 and the mandible) (+0.746 cm, $P < 0.0001$).

All items had significant differences between before and after the CGL.

DISCUSSION

After the operation, the hyoid bone was seen to have moved downward, and the cranial bone was observed to have rotated forward. As a result, the hypopharynx and oropharynx were expanded (Fig. 2). The ratio of air resistance and of airflow in the hypopharynx

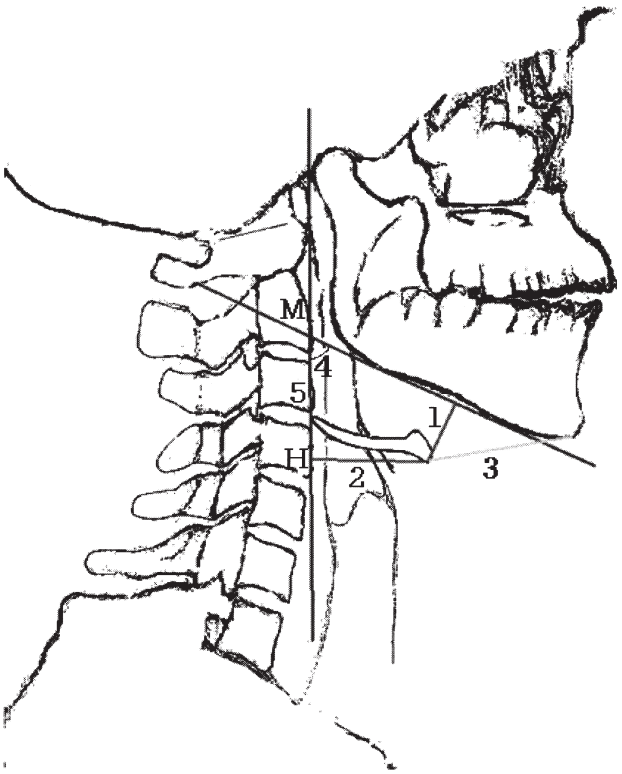

Figure 1. Locus of measured items. 1, The shortest vertical length between the hyoid bone and mandible. 2, A vertical length between the hyoid bone and the tangent of C2–4. 3, The shortest length between the hyoid bone and the chin. 4, The angle of the hyoid bone and the tangent of C2–4. 5, The length of H–M (H is an intersection of a tangent of C2–4 and vertical line from the hyoid bone. M is an intersection of a tangent of C2–4 and the mandible).

before and after the CGL can be calculated by Navier-Stoke's equation, if we assume that the hypopharynx is an oval tube. The flow of ideal gas Q can be calculated as follows:

$$Q = \frac{\pi \Delta p}{4vl} \times \left(\frac{a^3 b^3}{a^2 + b^2} \right)$$

By this equation, it was calculated that the ratio of the resistance after the operation was 0.238 and the airflow ratio was 4.196, in the presented case (Fig. 2). This result suggests an increase in the width of the hypopharynx is very effective for flow in the upper airways. The CGL can be performed under local anesthesia, and it only takes a short time. We recommend this operation for those who have symptoms of sleep disorders.

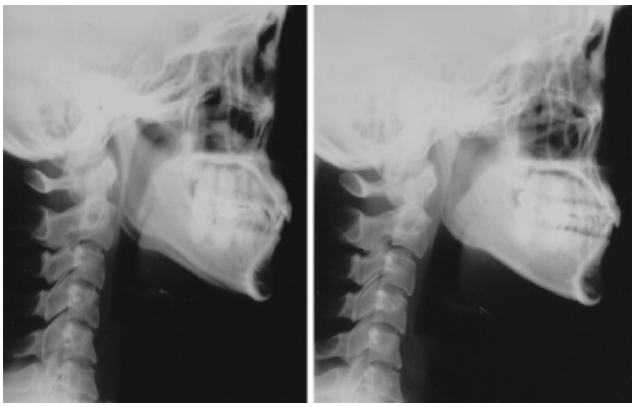

Figure 2. Head and neck X-ray before and after correction of glosso-larynx (CGL). A 25-year-old female. Left, before CGL; right: after CGL. The ratio of the resistance after the operation was 0.238 and the airflow ratio was 4.196, in this case.

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